C·R·E·S®
CENTER FOR REPRODUCTION OF ENDANGERED SPECIES

REPORT
WINTER 1999

The California Condor Recovery Program: Slow But Steady Progress

To nonbiologists, it may seem to be taking an inordinate amount of time to bring back the California condor. If there is one thing to be learned by working in endangered species recovery programs, it is that the biology of each species, and the complex, unique way they interact with their surrounding environment, requires solutions tailored to individual circumstances. Taxonomically, we separate species because of their differences, so it should not be surprising that recovery requires species-specific solutions.

Condors are different from most bird species in that everything about them appears extreme. A scoring continuum known as a species Natural History Strategy uses the symbols "r" and "K" to denote the extremes of the range, where "r" represents species with a rapid rate of population increase. Here, "r-selected" species generally have small body size, breed at a young age, have many young, and invest little in parental care. Their environments are less predictable, and population size may vary dramatically from year to year. Species such as quail, small birds of prey, and songbirds can quickly rebound in population size after a year of low population survivorship. A "K-selected" species, such as condors, large eagles, and cranes, shows opposite features. They have evolved around a niche requiring a relatively stable environment. The condors' slow reproduction rate of one chick every two years in nature and a slow maturity rate, taking five to six years before sexual maturity is reached, also dictates that any program relying on the production of large numbers of birds will take time.

We are fortunate for the several positive natural history and biological attributes the species brings to the program. A California condor has a long life-span of 50 to 60 years. It is a large, hardy species that presents few traumatic injuries in captivity and is extremely resistant to disease, most likely due to the natural selective pressures found around the rich pathogenic environment of its carrion food. A highly social species, it is very plastic (flexible) in its behavior. Still, it took CRES and other program researchers a decade to sort out how best to raise condors, continually readjusting rearing environments to maximize reproduction in captivity.

In the two decades since we first began building a captive-breeding program in 1982, the Zoological Society of San Diego and its program partners have more than eight times increased the population, from its all-time low of fewer than 30 birds in 1984, to today's population of more than 160 condors. While saving the species from extinction has been no small accomplishment, it represents only the first stage toward our overall

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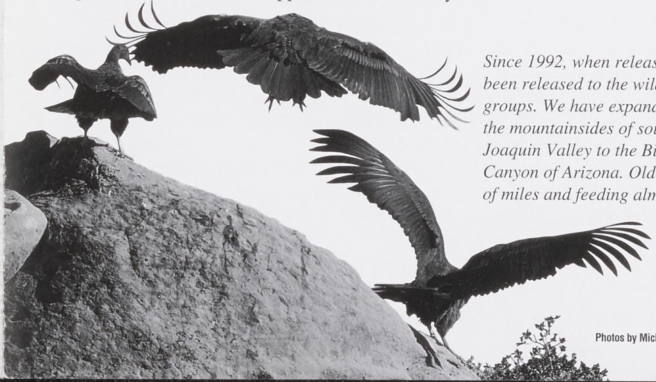
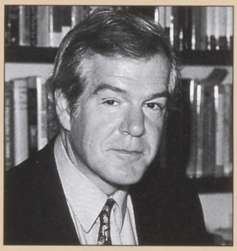


Since 1992, when releases began, 88 condors have been released to the wild in 18 different release groups. We have expanded our release sites from the mountainsides of southern California's San Joaquin Valley to the Big Sur coast and the Grand Canyon of Arizona. Older birds are flying hundreds of miles and feeding almost exclusively on their own. Within a year, the Society's biologists may be releasing condors in northern Baja.

Photos by Michael Wallace

CRES® is operated by the Zoological Society of San Diego.

At Last—A Giant Panda Birth!
CRES endocrinology and behavior studies helped to pinpoint estrus.
See page 3.



Dr. Alan Dixson Heads CRES
A new director is welcomed in October.
See back cover.

Seeing Triple: Tiger Cubs at the Zoo
Adopt a tiger for the holidays and help CRES!
See page 4.

The California Condor Recovery Program: Slow But Steady Progress

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recovery plan goals of establishing at least two separate, healthy populations in the wild, each of 150 or more birds. The captive flock should number at least 150 birds as well, for a total of 450 birds in the overall population. Based on our population models that calculate current and future breeding rates, this level of a condor population should be reached sometime between 2015 and 2020. At that point, the species will be downlisted from endangered to threatened but may never be removed from the threatened list, always needing some degree of management.

While the breeding program has gone exceedingly well, the process of establishing condors in their former range is taking longer than hoped. The social nature of the species makes studying them more like working with social mammal carnivores or primates. Young wild condors normally rely for years on their parents and other adults in the population to learn how to forage collectively, what to feed on, where to roost and find safe water sources. Because we supplement released condors with food at the release site, the subsidy allows them time to gradually learn most of these basics, although not without some degree of confusion in the process.

In 1992, based on founder representation and numbers of birds, enough reproduction at the two zoos in San Diego and Los Angeles allowed us to consider the release of condors to the wild. Only two California condors were available for release that first year. Along with two young Andean condors, to round out the group socially, they were released without incident. Of 13 Andeans released in California as a test over a 3-year period, only 1 died, and it was of a collision with a power line. In contrast, of the first 13 California condors released later in the same area over only a 2-year period, 4 were lost to power line collisions and 1 to ethylene glycol (antifreeze) poisoning. While the incident with antifreeze appears to be a rare incident, the collision cases were disturbing. Mortality rates that high would greatly diminish the possibility of success of the program. In 1995, we began an aversion training experiment at the Los Angeles Zoo to test the possibility of dissuading newly released birds from using power pole crossarms as day perches and nighttime roosts, which they all had become accustomed to do as they flew into new habitats.

Instead of sending the fledgling-age birds to the release pens in the wild, we allowed them to learn to fly in large flight aviaries at the zoo. The pens contained several natural perches, as well as a single mock power pole that gave a mild but uncomfortable electric shock when any condor attempted to perch on it. Time-lapse cameras monitored the birds and found that after from one to six attempts, the birds stopped trying to use the mock power pole as a perch. So far all condors released to the wild after receiving this Pavlovian type of conditioning have avoided landing on power poles in their habitat, regardless of the pole's design. Subsequently released birds appear to be learning from the birds that had direct experience with the mock pole. As hoped, this mortality factor has been reduced, since we have lost only one condor to power lines since 1995.

Condors as scavengers are innately curious: any activity on the landscape should be noted because it may indicate the availability of food. As naive condors begin flying greater distances, they invariably encounter people camping, hiking, or mountain biking. Most interactions with people today are not negative, with people approaching the birds to get a closer look or take a photo. Without adult condor guidance, a group of naive condors is as brave as the most daring individual in the cohort and this can lead them into trouble. At higher mountainous altitudes, where the condors fly, they have been known to approach closely to campers, land on rooftops, and even enter buildings. Attempts to dissuade the birds by chasing them from the areas, once bad behavior is observed in the wild, has been largely ineffective. While this behavior is exhibited only 5 to 10 percent of the time, it has led us once again to aversion training during the rearing process and prior to release.

Although effective in the zoo setting, the process of making birds wary of people is difficult training to maintain in the wild. We have also noted that parent-reared birds seem to be more innately wary than birds we have reared in groups, using puppets (see photo at left) to feed them. Experiments have been initiated this season that adjust our rearing techniques so that puppet-reared chicks experience an environment that is more like that of parent-reared birds, and this seems to be producing better results.

We also observe that while young captive birds are intensely curious about their environment and test everything, they become less inquisitive as they mature. At ages five and six, they appear to focus more on what other pairs are doing and begin defending nesting territory. We hope that the released birds will behave in a similar way as they reach maturity, like wild condors of the past. Just as we have had to work through many problems with incubation and captive husbandry, we must be ready to modify the way we manage releases in order to produce condors better suited to life in the wild. While the process to save the California condor seems long, recovery can only unfold at the rate dictated by the species. Step by slow step, we are coming closer to our recovery goals, and within the next few years, we should see condors raising their own young in the wild.

—Michael Wallace, Ph.D., Reintroduction Specialist, Applied Conservation Department

Behavior and Endocrinology

Breeding giant pandas in captivity has never been easy, because the female's springtime estrus is so brief, often just a day or two, and difficult to pinpoint. After attempts at natural mating failed during the last three years for the San Diego Zoo's panda pair, Bai Yun and Shi Shi, artificial insemination was the next step. This could not be attempted until Bai Yun's time of ovulation could be determined. The CRES endocrinology division processed her daily urine samples, looking for a sharp rise and fall in estrogen levels. Based on this information, artificial insemination took place for three consecutive days, beginning on April 9. The subsequent urinary progestin pattern indicated that ovulation had occurred and that pregnancy or pseudopregnancy was in progress. Since it could not be determined by laboratory tests whether Bai Yun was having a pregnancy or a pseudopregnancy, the staff was excited to detect a fetus in an ultrasound exam performed on August 18.

There was even greater excitement at the Zoo's Pacific Bell Foundation Giant Panda Research Station on August 21, at 11:40 A.M., when a panda cub was born to Bai Yun. The staff was reassured by the infant's noisy vocalizations from the time of birth, and Bai Yun has proven to be an excellent and attentive mother. We have renewed hope that this birth is only the first in a successful breeding program for this highly endangered species, and we look forward to thoroughly enjoying our infant panda as she grows up and adds to our knowledge of panda reproduction and behavior.

Cans for Critters' 20th Anniversary!

Joan Embery, the Zoological Society's Goodwill Ambassador, Jammin' Z90, Zoo mascots, and Del Mar Hills Elementary School joined forces in September to celebrate the 20th anniversary of Cans for Critters. Six hundred students were treated to a visit from Leigh Childs, one of the program's pioneers, Zoo mascot Sydney Koala, and Joan Embery and her team, who put on a fabulous presentation. Students and teachers had a rare close-up look at Joan's cheetah, anteater, boa constrictor, macaw, and cockatoo. They were reminded how important recycling is and how their contribution to the program benefits endangered species and conservation through the work at CRES. A wonderful time was had by all in commemorating the program's 20 years of successful recycling. We would like to thank everyone who has participated over the past two decades and for their contributions to the $300,000 that has been raised.

For more information on what your organization, school, troop, or company CAN do to help CRES and the environment, please call Tamara Langmead at (619) 744-3362.

Join us on Saturday, January 22, for our CANDEMONIUM 2000 drive opener! Just drop off a grocery bag full of aluminum cans at the Cans for Critters recycling domes at the front of the Zoo from 9 A.M. to 3 P.M. and receive free entry to the Zoo. (Valid for January 22, 2000, only.)

CRES "Wish List"

The work is never done for scientists at CRES as they continue studies on reproduction, diseases, and habitat conservation for endangered species. Current projects are in need of specialized equipment and supplies, which include:

- ✔ **Universal mutation detecting system.** This is a system developed to rapidly screen DNA for sequence differences. The virology/immunology division uses this to study immune system genes, especially in rhinoceroses, koalas, and cheetahs—*$7,500.*
- ✔ **Liquid nitrogen storage system.** This unit will enhance the smaller units used by virology/immunology. The storage units house frozen virus samples and cell lines used to conduct research on various species—*$11,500.*
- ✔ **Thermal cycler.** An essential tool for laboratories conducting work in molecular biology. It will be used by the endocrinology division with projects to identify sex determination in alligators, as well as for identification of individual free-ranging rhinoceroses —*$8,500.*
- ✔ **Ultracold freezer.** Blood samples for vitamin assays and tissues for molecular studies will be stored in this freezer. Sea turtle studies by the endocrinology division will greatly benefit from the addition of this freezer—*$8,500.*
- ✔ **Digital camera.** Used by the behavior division to facilitate data analysis of behavioral patterns in red pandas, cheetahs, Geoffroy's marmosets, and drills—*$1,100.*
- ✔ **Field scale.** A precision scale for use by the behavior division in weighing neonates, especially cheetah cubs at the Wild Animal Park—*$1,500.*
- ✔ **Laminar flow hood.** Needed by the reproductive physiology division for the sterile preparation of media for oocyte culture. For long-term culture, the hood is needed to maintain warm, sterile conditions during examination of oocytes from various species—*$8,500.*

For information on funding these projects, please call Amy Parrott at (619) 685-3213.

1999 Bonner College Student Research Fellows

Since 1994, a number of promising young scientists have benefited from the Bonner Summer College Student Fellowship Endowment Fund. Jewell H. and James T. Bonner established this fund to sponsor summer interns working on various research projects at CRES that are dedicated to the preservation and protection of wildlife. You can be a part of these endeavors by helping to sponsor one of our CRES summer fellows. For more information, please call Amy Parrott in the development office at (619) 685-3213.

During the summer of 1999, scientists in the virology/immunology division at CRES enjoyed working with two undergraduate college students. Amanda Bowman, a senior at Roger Williams College in Rhode Island, was a recipient of a Bonner student fellowship. She was joined by Pamela Giam, a native of Singapore, who had finished her first year at the University of Southern California. Both students worked with Carrie LeDuc, laboratory coordinator, and Gabriel Maalouf, laboratory assistant, in investigating specific aspects of the immune system in four rhinoceros species. Although concentrating their efforts on the eastern and southern subspecies of the African black rhino, the group also examined samples from the African white rhino, as well as from Indian and Sumatran rhinos.

The objective of their research was to initiate a study to determine whether one could detect specific "ecotypes" of black rhinos, based on differences in DNA sequences in the major histocompatibility complex (MHC). Certain genes within the MHC play a major role in the immune response to pathogenic organisms. The immune recognition regions within these genes are highly genetically variable, or polymorphic, and some scientists believe that this polymorphism is selected and maintained by exposure to the microbial environment. Therefore, if populations of a species—in this case, rhinos from geographically distinct regions of a country or continent—lived in environments with distinct microbial flora, these populations, in general terms, might then possess regional patterns of DNA sequence in these polymorphic regions of the MHC. If so, this information might be relevant to disease resistance or susceptibility and an important factor to consider in translocation programs.

In conducting this research, Amanda and Pamela were taught a variety of techniques that are routinely used in a molecular biology laboratory. These included DNA extraction from blood and tissues, amplification of DNA using polymerase chain reaction (PCR) methods, and cloning and sequencing of DNA. They were responsible for editing the sequences they generated and analyzed those sequences with a variety of computer programs. Although it is too early in the course of the study to determine whether there are "ecotypes" of black rhinos, based on MHC sequences, the results produced by Amanda and Pamela during their summer at CRES have provided a better understanding of the complexity of specific MHC genes in the black rhino.

Amanda Bowman (front) and Pamela Giam joined the CRES virology/ immunology division last summer to work on specific aspects of the immune systems in four rhino species.

—Michael Worley, D.V.M., Head of Virology/Immunology Division/CRES

Nikki Devins (seated) with Willow Gabriel and Dr. Valentine Lance, head of the CRES endocrinology division, worked together on radioimmunoassays for alligator studies.

The endocrinology lab also had two Bonner Fellows this summer. Nikki Devins is in her third year as a biology major at University College, Dublin, Ireland. This was her second visit to the United States and her first to California. During her 10 weeks at CRES, Nikki learned how to set up and run radioimmunoassays for reproductive steroid hormones in blood, urine, and feces, an she was able to achieve her wish: wor with alligators. The alligators she worked with, however, were still in the eggs, but she was lucky enough to see some of them hatch before she headed back to Dublin.

Willow Gabriel, our second Bonner Fellow, is a recent graduate of UC Santa Cruz who has worked as a volunteer giant panda behavior observer and a volunteer in the endocrinology lab. After being exposed to alligator embryos and temperature-dependent sex determination in reptiles, Willow has decided to pursue a master's degree in molecular biology. Her research project involves isolating RNA from embryonic tissues of alligators during the period of incubation when sex is determined, and then measuring the expression of a gene that we believe is involved in making the embryo a female. In addition to her research project, Willow helps with radioimmunoassays. We were fortunate to have two such dedicated students in the lab this summer.

—Valentine Lance, Ph.D.
Head of Endocrinology Division/CRES

Adopt a Tiger for the Holidays!

Go Wild this holiday season with one of the most unique gifts to be found while also helping endangered species. The Adopt-An-Animal Program helps support the research of our dedicated scientists at the Center for Reproduction of Endangered Species (CRES), in their quest to study endangered animals and their habitats. Current CRES studies include research work on feline immunodeficiency virus and early detection of pregnancy in tigers.

The birth of three Indo-Chinese tiger cubs born on June 10, one male and two females, is a first for the World-Famous San Diego Zoo. The birth of these cubs represents a significant increase in the captive population of this critically endangered species. You can visit them as they play and romp in Tiger River! Support CRES and the tigers with a holiday gift that will keep their future alive.

With your adoption package of $99, you can choose:

PACKAGE 1

- **10-inch Ty, Inc. plush baby tiger**
- **Adoption certificate**
- **Subscription to *CRES Report***
- **Gift card**

AND

- **Two complimentary guest passes to the San Diego Zoo or the San Diego Wild Animal Park**

or

PACKAGE 2

- **10-inch Ty, Inc. plush baby tiger**
- **Adoption certificate**
- **Subscription to *CRES Report***
- **Gift card**

AND

- **Custom black umbrella with wooden handle imprinted with CRES logo**
- ***Natural World* tiger book**

To order a gift adoption package, please call (619) 231-1515, ext. 4199, and don't forget to get one for yourself, too!

ANIMAL ADOPTION APPLICATION

☐ **YES,** I want to adopt a tiger for:

Choose: ☐ *PACKAGE 1* *or* ☐ *PACKAGE 2*

(Please print clearly for certificate.)

Name(s) ______________________________

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Gift Card To: ______________________________

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Additional tiger adoption, *choose:* ☐ *PACKAGE 1* *or* ☐ *PACKAGE 2*

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Address ______________________________

City ____________________ State _____ Zip __________

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Additional tiger adoption, *choose:* ☐ *PACKAGE 1* *or* ☐ *PACKAGE 2*

Name(s) ______________________________

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City ____________________ State _____ Zip __________

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From: ______________________________

Please make checks payable to the Zoological Society of San Diego and mail to: The Zoological Society of San Diego, Adopt-An-Animal Program, P.O. Box 120271, San Diego, CA 92112.

OR, please charge my: ☐ MasterCard® ☐ VISA® ☐ Discover®

Card # ____________________ Exp. Date __________

Signature ______________________________

Donor Name (print) ______________________________

Daytime Phone # ______________________________

OR, you may charge your adoption by telephone: call (619) 231-1515, ext. 4199, between 8 A.M. and 4 P.M., Monday through Friday.

Orders must reach the San Diego Zoo by December 15 to ensure delivery by Christmas.

(AHCR9)

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C·R·E·S REPORT
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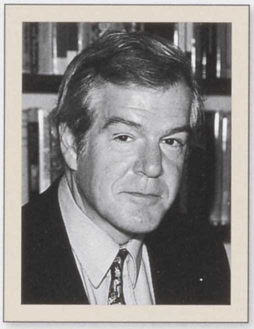
CRES Welcomes Its New Director



A renowned zoologist from the University of Cambridge, Alan Dixson, Ph.D., DSc, has joined the staff of the Zoological Society of San Diego to lead its Center for Reproduction of Endangered Species (CRES) as Director of Conservation and Science. Dr. Dixson, who has a special interest in field biology and conservation, began in October as director of conservation and science. He was selected after a year-long search to succeed the late CRES director, Dr. Werner Heuschele. "We look to Dr. Dixson, with his vast experience, forward thinking, and dedication to preserving the Earth's species, to lead our conservation and science endeavors into the next millennium," said Douglas G. Myers, the Society's executive director.

Most recently, Dr. Dixson was the head of the Medical Research Council Group on Development and Integration of Behavior, Zoology Department, University of Cambridge: Sub-Department of Animal Behavior, where he studied how hormones and environmental factors control the development of primate behavior in captivity and in the wild. "I believe we must place even greater emphasis upon research and conservation in the context of field studies," said Alan Dixson. "We can accomplish this by funding long-term fieldwork at carefully selected sites and by encouraging young scientists from the United States and from habitat countries to engage in this work. There is a real prospect of success here: both in preventing the untimely extinction of magnificent animals and in training young scientists who will move on to be ambassadors for the Zoological Society in the broader world of conservation science."

Dr. Dixson's fascination with field biology began in 1973, when he helped the late Dr. Dian Fossey conduct a census of the mountain gorilla population in Rwanda and the Democratic Republic of Congo (formerly Zaire). Since then, he has worked as a Traveling Research Fellow at the Oregon Primate Center; head of the Animal Behavior Unit at the Zoological Society of London; senior scientist at the MRC Reproductive Biology Unit, Edinburgh, Scotland; and director of the Primate Center in Gabon, West Africa. Some of his fieldwork has involved the use of radio tracking to study nocturnal primates, as well as DNA fingerprinting to examine mating systems and reproductive success of galagos, mandrills, and marmosets.

Dr. Dixson's varied career has enabled him to gain a broad knowledge of behavioral endocrinology, reproductive biology, genetics, and behavioral ecology, all of which will contribute to an informed and balanced leadership at CRES. The staff extends a warm welcome to Dr. Dixson.

C·R·E·S REPORT
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SAN DIEGO ZOO
SAN DIEGO WILD ANIMAL PARK

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